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(54)デイファレンシアルギヤーケース等の金属加工法

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図面の簡単な説明

図は本発明に係るデイファレンシアルギヤーケース等の金属加工法の一実施例を示し、第1図は本発明の加工法によつて作られたデイファレンシアルギヤーケースの平面図、第2図は同上のII－II線断面図、第3図は第1図のIII－III線を断面した場合の上下金型枠、ガイドシリンダー及び第1次製品の縦断側面図、第4図は同上の製造工程途中の縦断側面図、第5図は第1次製品を所定の型に成型したところを示す縦断側面図である。

発明の詳細な説明

本発明は例えばデイファレンシアルギヤーケース等の如く内部が拡つているケースを製造する加工法に関するものである。

従来、内部が拡つているケースを製造するのに金属板で形成する場合外枠はその形態により所要の型のものを製缶工程における如く組合せねばならず、又中枠に於いては組み立がまことに複雑となりこれを抜き取る際、順序よく解体できる如くしなければならないため、500噸級のプレスで、ケースとなる鉄板を部分的に打ち抜きこれを所定の型に膨出鍛造して成形し溶着した後、仕上をする等真に手間がかかる工程を経ており、出来上つた製品の肉厚が鍛造溶着等のため均一とならない欠点があつた。

又近年では何個かの部品を製作し、この部品を一体に組立てることによつて完成品としていたが、これにあつては幾つもの金型を必要とし、それだけ製作工程が増え組立て作業が面倒となり、従つてコストが高くなる等の欠陥を有するものであつた。

本発明は叙上の欠陥を是正する為に成されたもので、その目的とするところは、製品の寸法が正確で、且つ全ての肉厚が均一に製作し得るデイファレンシアルギヤーケース等の金属加工法を提供しようとするものであつた。

又本発明の他の目的とするところは、製品の加工途中に於いて成型材料が破断することがないので加工時失敗する等の虞れが全くないデイファレンシアルギヤーケース等の金属加工法を提供しようとするものである。

更に本発明の他の目的とするところは、1組の金型装置に於いて製品の成型ができるので組立て工程が大幅に削減し得るデイファレンシアルギヤーケース等の金属加工法を提供しようとするものである。

更に又本発明の他の目的とするところは、製品の成型が容易で量産に適し廉価に供給し得るデイファレンシアルギヤーケース等の金属加工法を提供しようとするものである。

次に本発明に係る金属加工法の一実施例をデイファレンシアルギヤーケースを製作する場合について説明すれば、AはフランジA_1を有する円筒絞りの第1次製品、Bは該第1次製品Aを圧延成型する為の金型装置である。尚第1次製品A及び金型装置Bは第1図の製品A'のIII－III線断面図、即ち製品を直角に切断しその切口側より見た図面である。

1は押下軸2を有する上金型で、その表面1aがデイファレンシアルギヤーケースA'の表面A'1と同形状に形成されている。

3は該上金型1が上方より密に嵌合されたガイドシリンダーで、その側面に油圧排出孔4が数本設けられている。

5は押上軸6を有する下金型で、その表面5aがデイファレンシアルギヤーケースA'の背面A'2

2

3

の形状と同じく形成されている。そしてこの下金型5も前記したガイドシリンダー3の下方より密に嵌挿されている。尚1b，5bは油漏れ止用リングである。又下金型5と押上軸6には連通する油圧送入孔7が穿たれている。

8は油圧ポンプ、9は油流入調節弁で、油圧ポンプ8を作動させ、油流入調節弁9を適宜に調節して油圧送入孔7へ油を送入する。

10は油排出調節弁で、ガイドシリンダー3より排出された油を油圧排出孔4を介してその流量を調節しながら排出するものである。

次に加工法について説明すれば、第1次製品AのフランジA_1を下金型5に嵌合した状態で該下金型5をガイドシリンダー3内に嵌挿する。（第4図）

次に油圧ポンプ8から油流入調節弁9で例えば鉄板を膨出せしめるのに要する圧力が300気圧の場合最高300気圧に設定された油を当初は油圧と関係なく下金型5の圧油孔7の任意の個所に設けた逆流防止弁（図面省略）を経て上下の金型1，5の間のガイドシリンダー3内部に位置する第1次製品Aの内部aから外側の間隙bに送り込んで空気と共にガイドシリンダー3の油圧排出孔4より噴出させ、油をシリンダー3内に充満する。油排出調整弁10は成型材料の破断圧力（成型材料が内外の圧力差によつて破断する限界即ち圧力に対する限界）以下例えば破断圧力を110気圧とした場合成型材の内外の圧力差を110気圧以下に設定することにより、即ちこの場合第1次製品Aの膨出に要する気圧が300気圧とした場合、該第1次製品A内部aの油圧を300気圧とし外部bは200気圧程度以上に設定することにより成型材料内外の油圧の関係は破断圧力以下となり、油圧を300気圧で送り込んだ場合、第1次製品A内部aの油が下金型5と第1次製品Aの接触部のフランジA_1の圧接部より漏洩したときでも常に第1次製品Aの外部bでは200気圧となり調節弁8，10の設定圧力と等圧となる。

更に上下金型1，5のツバ1c，5cがガイドシリンダー3に当接するまで上下金型1，5を油排出調節弁10の設定圧力（200気圧）に打勝つて急激に油圧プレスで加圧すると、下金型5と第1次製品AのフランジA_1との圧接面からの油の漏洩並びに外部bにある油が油排出調節弁10

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の限界の200気圧に達し200気圧を越した場合は逐次シリンダー3の油圧排出孔4から流出する状態となり、成型材料内の気圧は油流入調節弁9の設定圧力の300気圧となつているので成型材料は破断圧力の限界内で破断することなく油圧と金型1，5の加圧の同作用で第1次製品Aは金型壁に接しながら膨出成形されるものである。尚膨出部A_2分は瞬間的に油圧と金型1，5の加圧で延伸されるため製品の肉厚は均一となるものである。

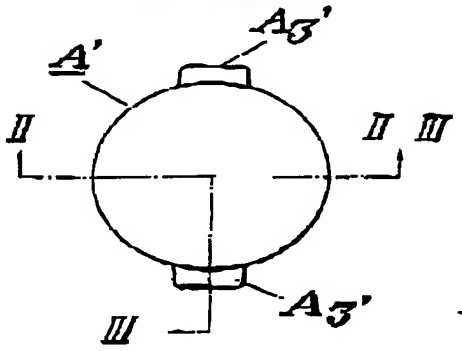
次に金型1，5内の油圧を抜きアキュームレーター（窒素と油を収容するタンクで通常油の流量圧等の調節に使用するものであるが、この場合は窒素の強力な反撥力により油圧を急激に上げる目的のために使用する）に蓄圧された油を下金型5の油圧送入孔7から急激に窒素の力で加圧して製品に衝撃を与えることによつて製品のスプリングバック（通常油圧と金型の加圧で成型した製品は成型直後跳ね返りと称し幾ひ如何結果が現われること）を除去し精密な製品を得るものである。

本発明は上記した様にガイドシリンダーの上下端より嵌挿した上下金型間に成型材料を挿入し、之を油圧プレスで加圧し製品を得るものであるから組立て等の手間を要することなく容易に製作でき、又調節弁によつて成形材料内外に於ける油圧の圧力差を制御する様にしたから、該成形材料に破断が生ずることがなく従つて製造上の失敗が全くなく、更に成型後の成型品にアキュームレーターで衝撃を与えスプリングバックを防止したので、規格通りの製品が得られる外、製造工程が少ないから量産に適し廉価に供給し得る等の効果を有するものである。

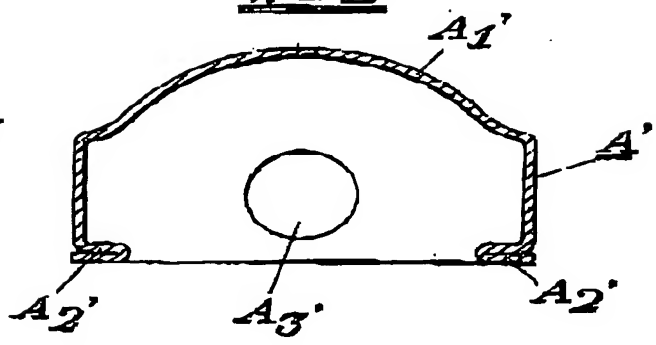
特許請求の範囲

1　ガイドシリンダーに嵌挿される上下金型内に成型材料を挿入し、該成型材料と一方の金型とによつて生じる内側空間と、該成型材料と前記したガイドシリンダーとによつて生じる外側空間との間に油を送入すると共にその内側空間との圧力差を成型材料に破断が生じない様に調節弁で制御し、且つ金型の加圧と油圧による膨出の両作用で成型し、然る後内外空間内の油圧を抜いてアキュームレーターで成型品に衝撃を与えて成るデイフレンシアルキヤーケース等の金属加工法。

第1図



第2図



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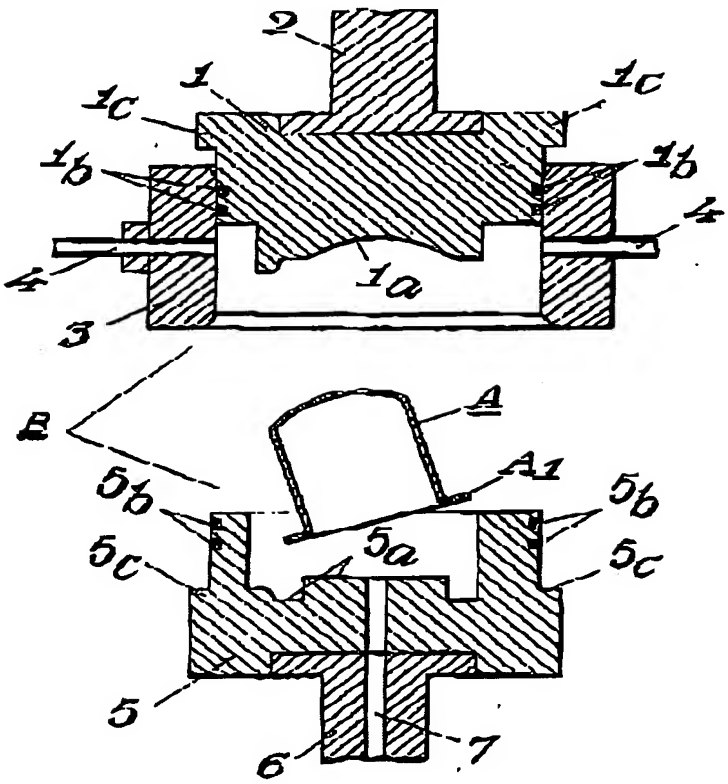
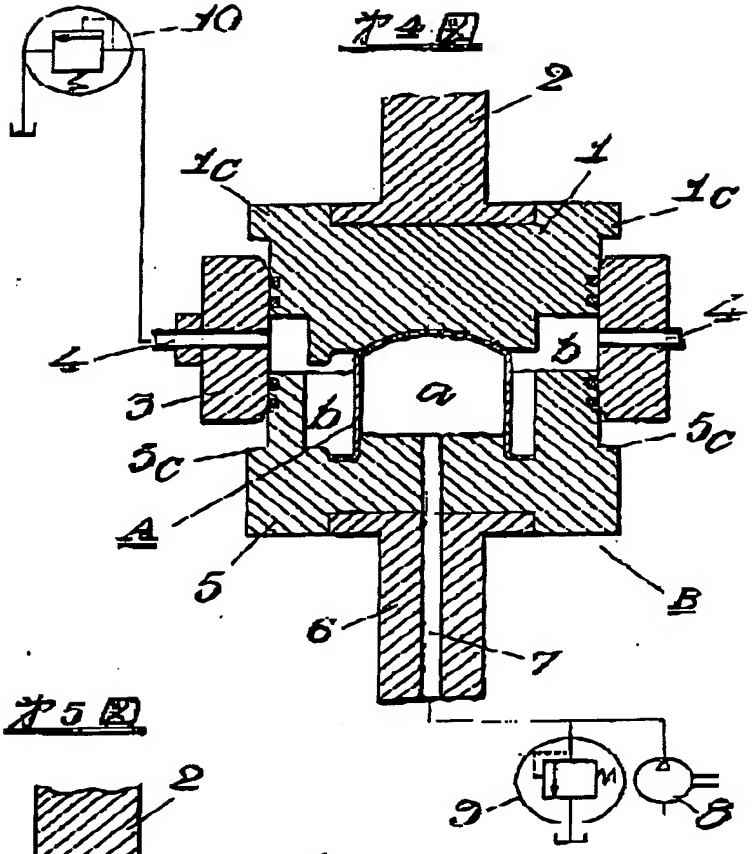
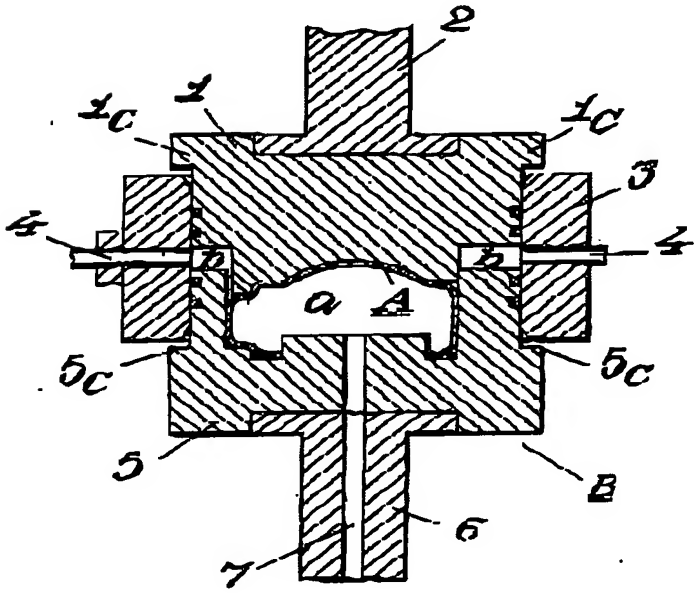


第4図



第5図



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Inventor: Same as Applicant

Applicant: Nariyoshi Ariha
54 Uenakano, Okayama-shi

Attorney: Patent Attorney Bunzo Takino

Simple Explanation of the Drawings

Fig. 1 shows an embodiment example of the method for metal working of differential gear cases according to this invention. Fig. 1 is a plan-view drawing of a differential gear case manufactured by the metal working method according to this invention, Fig. 2 is a longitudinal-section drawing along line II-II in Fig. 1, Fig. 3 is a longitudinal-section side-view drawing of the upper and lower die frames, guide cylinder, and primary product through line III-III shown in Fig. 1 being cut across, Fig. 4 is a longitudinal-section side-view drawing during the manufacturing process shown above, and Fig. 5 is a longitudinal-section side-view drawing showing primary product forming in a prescribed type of die.

Detailed Explanation of the Invention

This invention relates to a metal working method for manufacture of internally expanding cases, such as eg differential gear cases.

The outer frame conventionally obtained by metal plate forming for manufacture of internally expanding cases necessarily involves, as in manufacturing processes, pre-

scribed types of dies being combined depending on its shape. The central frame also involves a highly complex assembly process. When the latter are being taken out, this must be done in such a way as to allow effective dismantling. To achieve this, the steel plate envisaged for the case passes through various laborious manufacturing processes, being initially partially punched in a 500 ton class press, formed by die (expansion) forging in a prescribed type of die ensuring good metal deposition, and then finished to shape, a deficiency being that, because of forging material deposition, the completed product lacks a uniform wall thickness.

Recent years have further seen some products being manufactured from a number of partial products, which are integrally assembled to form complete products. This approach, however, implies the need to have various sets of dies available, with the deficiency of assembly and production becoming progressively more complex as the number of manufacturing processes increases in a way that implies heavy costs being incurred.

This invention has been elaborated to overcome the foregoing deficiencies, its purpose being to propose a method for metal working of differential gear cases whereby products with accurate dimensions and completely uniform wall thickness can be obtained.

A further purpose of this invention is also to propose a method for metal working of differential gear cases whereby products can be obtained entirely without the risk of metal working process failure through the forming material being free from fracture during the working process.

A further purpose of this invention is also to propose a method for metal working of differential gear cases whereby the assembly process can be substantially reduced through product forming being able to proceed in a single set of die devices.

A further purpose of this invention is also to propose a method for metal working of differential gear cases whereby product forming is easily accomplished and products can be manufactured at low cost corresponding to volume production.

An embodiment example of the method for metal working of differential gear cases according to this invention is next explained with reference to differential gear case manufacture. A is a circular cylindrical drawn product with flange A_1. B is a die device for compression forming of said primary product A. Primary product A and die device B are shown in a cross-sectional drawing along product A' line III-III in Fig. 1, ie in a drawing representing the product being cut at right angles and viewed from the cut opening side.

1 is an upper die incorporating press-down shaft 2, its surface 1a being formed to the same shape as surface A'_1 of differential gear case A'.

3 is a guide cylinder wherein upper die 1 is snugly fixed from above, its side surface being provided with multiple oil pressure exhaust holes 4.

5 is a lower die incorporating press-up shaft 6, its surface 5a being formed to the same shape as surface A'_2 of differential gear case A'. Lower die 5 is also snugly inserted

in said guide cylinder 3 from below. 1b, 5b are oil leakage check rings. Communicating oil delivery manifold 7 also penetrates inside lower die 5 and press-up shaft 6.

8 is a hydraulic pump. 9 is an oil inflow regulating valve. Oil is delivered to oil delivery manifold 7 through hydraulic pump 8 being operated and oil inflow regulating valve 9 being regulated as appropriate.

10 is an oil exhaust regulating valve, being arranged to exhaust oil with the flow rate of oil exhausted from guide cylinder 3 being regulated via oil pressure exhaust holes 4.

The metal working method according to this invention is next explained. Said lower die 5 is inserted inside guide cylinder 3 in a state of flange A_1 of primary product A being fixed inside lower die 5 (Fig. 4).

When a pressure of 300 atmospheres is required to expand eg a steel plate, oil set to a pressure of max 300 atmospheres by oil inflow regulating valve 9 from hydraulic pump 8 is delivered into outside gap b from inner zone a of primary product A located inside guide cylinder 3 between upper and lower dies 1, 5 via a non-return valve (not shown) provided at any arbitrary location in oil delivery manifold 7 of lower die 5 in a way initially unrelated to the oil pressure and then sprayed from oil pressure exhaust holes 4 of guide cylinder 3 together with ambient air in order to fill oil inside guide cylinder 3. When the fracture pressure is less than the forming material fracture pressure (the limit of forming material fracture due to the inside and outside pressure difference, ie the pressure limit), such as eg at a fracture pressure of 110 atmospheres, through oil exhaust regulating valve 10 being arranged to set the pressure difference inside and outside the forming material to 110 atmospheres or less, ie, when the pressure required to expand primary product A in this case is 300 atmospheres, the pressure of inner zone a of primary product A is set to 300 atmospheres, and outer zone b is set to a pressure of around 200 atmospheres or more, so that the relationship between the oil pressure inside and outside the forming material is less than the fracture pressure. During delivery at an oil pressure of 300 atmospheres, despite oil in inner zone a of primary product A leaking from the compression zone of flange A_1 in the contact zone between lower die 5 and primary product A, a pressure of 200 atmospheres is normally obtained in outer zone b of primary product A, attaining the same pressure as the pressure set in regulating valves 9, 10.

Until flanges 1c, 5c of upper and lower dies 1, 5 come into contact with guide cylinder 3, provided upper and lower dies 1, 5 are intensely pressurized in a hydraulic press to overcome the set pressure (200 atmospheres) of oil exhaust regulating valve 10, oil leakage from the compression zone between lower die 5 and flange A_1 of primary product A coupled with oil available in outer zone b results in a pressure of 200 atmospheres being attained as the limit of the pressure set by oil exhaust regulating valve 10. Should a pressure of 200 atmospheres be exceeded, oil is arranged to flow out successively from oil pressure exhaust holes 4 of guide cylinder 3. The atmospheric pressure inside the forming material then becomes 300 atmospheres as the pressure set by oil inflow regulating valve 9, so that, through both functions of oil pressure and pressurization of dies 1, 5, entirely without forming material fracture within the fracture pressure limit, primary product A is expanded and formed while in contact with the die wall. Expansion zone A'_3 is also instantaneously extended by oil

pressure and pressurization of dies 1, 5 to obtain a product with a uniform wall thickness.

When the oil pressure of dies 1, 5 is then removed, the oil pressurized in an accumulator (a device operating to adjust the normal oil flow rate pressures in a tank containing nitrogen and oil, being used in this case to boost the oil pressure significantly as a result of the intense reaction force of nitrogen) is intensely pressurized by the force of nitrogen from oil delivery manifold 7 of lower die 5 to impose a heavy shock on the product. By this means, product spring-back (products formed by oil pressure and die pressurization normally sustain a shrinkage-like effect known as spring-back just after forming) is eliminated to obtain a precision product.

Through a forming material being inserted between upper and lower dies fixed from upper and lower ends of a guide cylinder and through the latter being pressurized in a hydraulic press to obtain a precision product according to this invention as described above, product manufacture can be easily accomplished without any laborious assembly operations being required. Through the pressure difference of the oil pressure inside and outside the forming material being controlled by regulating valves, said forming material sustains no fracture whatever, any manufacturing process failure is accordingly entirely eliminated, and product spring-back is prevented through an intense shock being imposed on the product by an accumulator just after forming in a way that enables good-quality products to be obtained. Through fewer manufacturing processes being required, the invention further confers the effect of products being able to be supplied at low cost corresponding to volume production.

Claims

1. Method for metal working of differential gear cases arranged so that a forming material is inserted between upper and lower dies fixed in a guide cylinder, oil is supplied between an inside space created by said forming material and one die and an outside space created by said forming material and said guide cylinder, the pressure difference with the inside space is controlled by regulating valves so that said forming material sustains no fracture, material forming is accomplished by both functions of die pressurization and expansion due to oil pressure, and an intense shock is then imposed on the formed product by an accumulator as the oil pressure inside the inside and outside spaces is removed.

Fig. 1

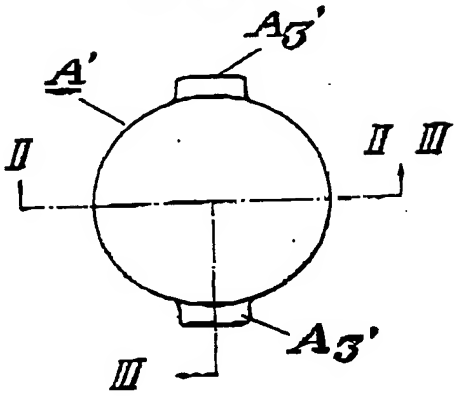
Fig. 2

Fig. 3

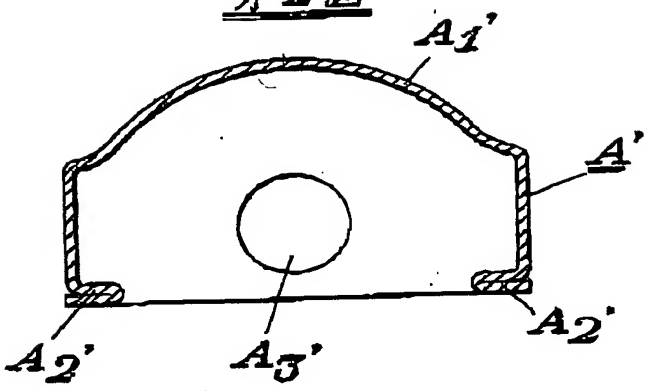
Fig. 4

Fig. 5

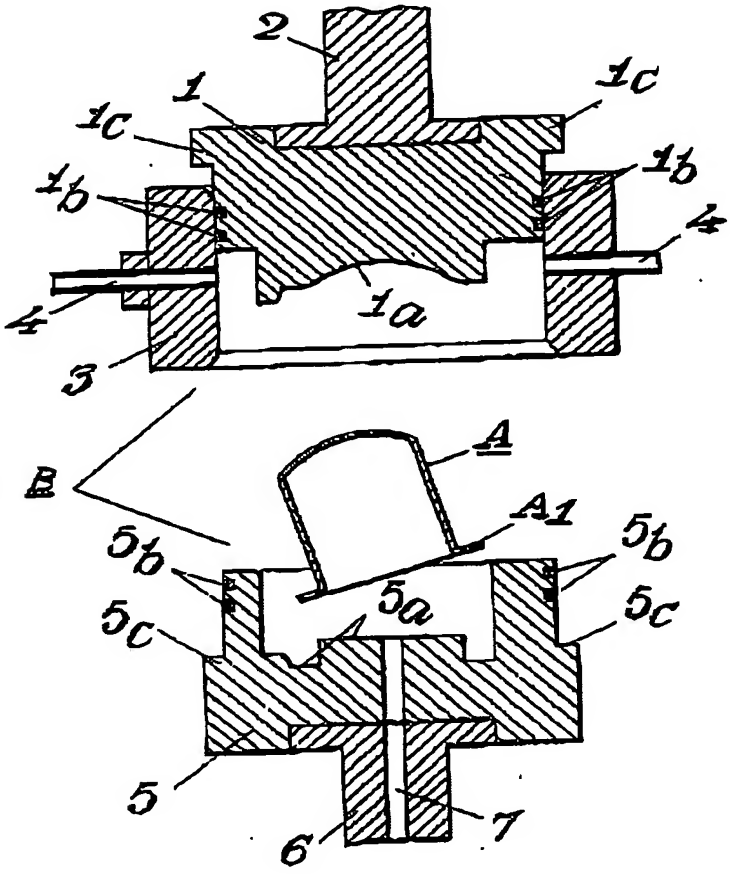
第1図


A3'
A'
II
II III
A3'
III

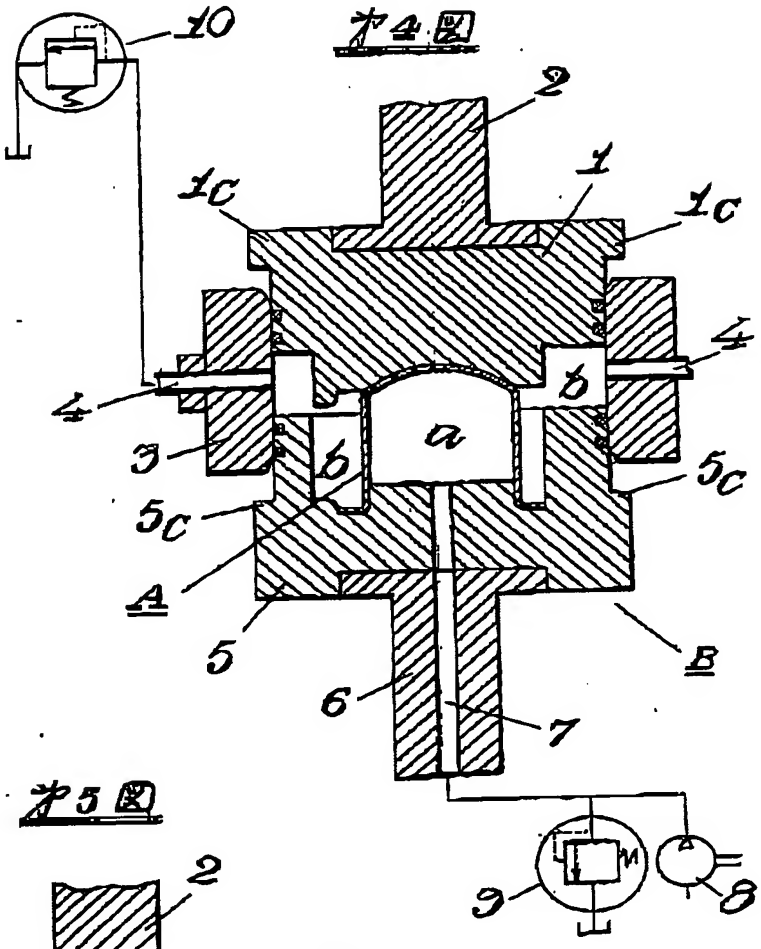
第2図


A1'
A'
A2'
A3'
A2'

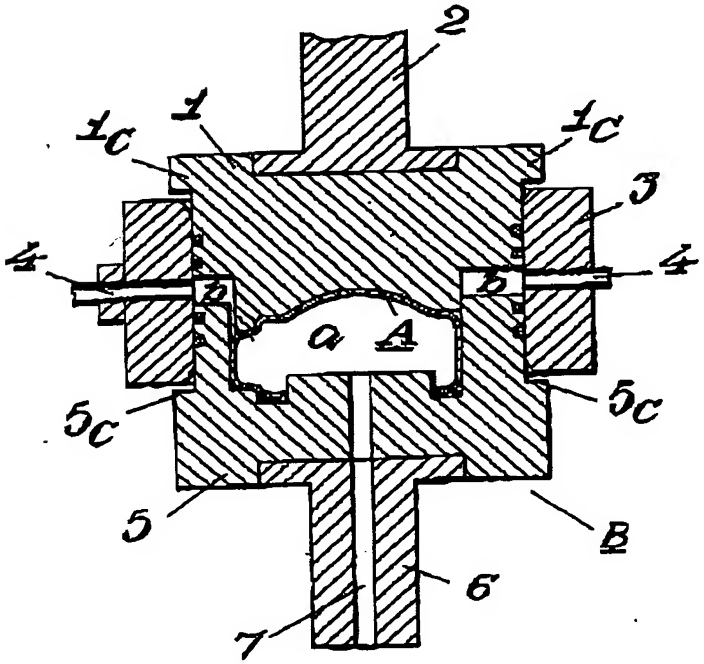
第3図


2
1
1c
1c
1b
1b
4
4
1a
3
B
A
A1
5b
5b
5a
5c
5c
5
6
7

第4図



第5図



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Summary of JP46-26784

1. Explanation of reference numbers in Figures.

A' : differential gear case.
A : primary product
3 : guide cylinder
1 : upper punch
5 : under punch
8 : hydraulic pump
9 : regulating valve for inputting
10 : regulating valve for exhausting

2. The following invention is described.

The oil is filed into inner region (*a*) and outer region (*b*) of the primary product in the guide cylinder 3(Fig. 1). The primary product is deformed by the oil pressure and pressing with the upper punch 1 and the under punch 5 while contacting the die wall. The difference between the oil pressure of inner region (*a*) and the oil pressure of outer region (*b*) is set less than the rupture stress by the regulating valve 9 and the regulating valve 10.